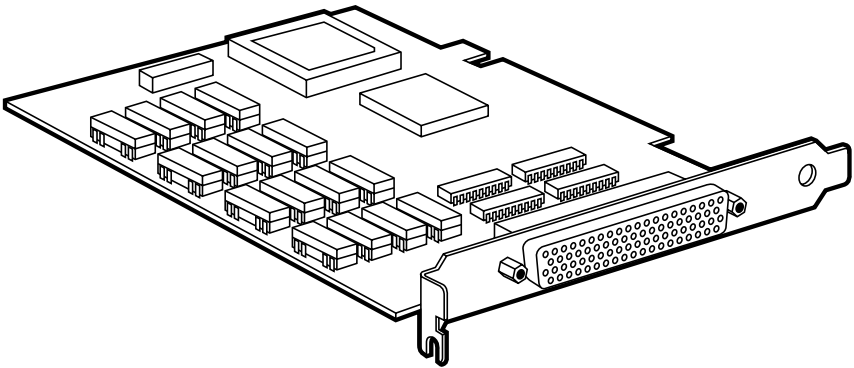




Digital I/O Card-16



**CUSTOMER
SUPPORT
INFORMATION**

Order **toll-free** in the U.S. 24 hours, 7 A.M. Monday to midnight Friday: **877-877-BBOX**
FREE technical support, 24 hours a day, 7 days a week: Call **724-746-5500** or fax **724-746-0746**
Mail order: **Black Box Corporation**, 1000 Park Drive, Lawrence, PA 15055-1018
Web site: www.blackbox.com • E-mail: info@blackbox.com

**FEDERAL COMMUNICATIONS COMMISSION
AND
INDUSTRY CANADA
RADIO FREQUENCY INTERFERENCE STATEMENTS**

This equipment generates, uses, and can radiate radio frequency energy and if not installed and used properly, that is, in strict accordance with the manufacturer's instructions, may cause interference to radio communication. It has been tested and found to comply with the limits for a Class A computing device in accordance with the specifications in Subpart B of Part 15 of FCC rules, which are designed to provide reasonable protection against such interference when the equipment is operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference, in which case the user at his own expense will be required to take whatever measures may be necessary to correct the interference.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This digital apparatus does not exceed the Class A limits for radio noise emission from digital apparatus set out in the Radio Interference Regulation of Industry Canada.

Le présent appareil numérique n'émet pas de bruits radioélectriques dépassant les limites applicables aux appareils numériques de la classe A prescrites dans le Règlement sur le brouillage radioélectrique publié par Industrie Canada.

CE Compliance

Products bearing the CE label fulfill the requirements of the EMC directive (89/336/EEC) and of the low-voltage directive (73/23/EEC) issued by the European Commission.

To obey these directives, the following European standards must be met:

- **EN55022 Class A** — “Limits and methods of measurement of radio interference characteristics of information technology equipment.”
- **EN50082-1** — “Electromagnetic compatibility—Generic immunity standard.”
 - Part 1: Residential, commercial, and light industry.
- **EN60950 (IEC950)** — “Safety of information technology equipment, including electrical business equipment.”

WARNING

This is a Class A Product. In a domestic environment, this product may cause radio interference in which case you may be required to take adequate measures.

Always use cabling provided with this product if possible. If no cable is provided or if an alternate cable is required, use high-quality shielded cabling to maintain compliance with FCC/EMC directives.

NORMAS OFICIALES MEXICANAS (NOM) ELECTRICAL SAFETY STATEMENT

INSTRUCCIONES DE SEGURIDAD

1. Todas las instrucciones de seguridad y operación deberán ser leídas antes de que el aparato eléctrico sea operado.
2. Las instrucciones de seguridad y operación deberán ser guardadas para referencia futura.
3. Todas las advertencias en el aparato eléctrico y en sus instrucciones de operación deben ser respetadas.
4. Todas las instrucciones de operación y uso deben ser seguidas.
5. El aparato eléctrico no deberá ser usado cerca del agua—por ejemplo, cerca de la tina de baño, lavabo, sótano mojado o cerca de una alberca, etc..
6. El aparato eléctrico debe ser usado únicamente con carritos o pedestales que sean recomendados por el fabricante.
7. El aparato eléctrico debe ser montado a la pared o al techo sólo como sea recomendado por el fabricante.
8. Servicio—El usuario no debe intentar dar servicio al equipo eléctrico más allá a lo descrito en las instrucciones de operación. Todo otro servicio deberá ser referido a personal de servicio calificado.
9. El aparato eléctrico debe ser situado de tal manera que su posición no interfiera su uso. La colocación del aparato eléctrico sobre una cama, sofá, alfombra o superficie similar puede bloquea la ventilación, no se debe colocar en libreros o gabinetes que impidan el flujo de aire por los orificios de ventilación.
10. El equipo eléctrico deber ser situado fuera del alcance de fuentes de calor como radiadores, registros de calor, estufas u otros aparatos (incluyendo amplificadores) que producen calor.
11. El aparato eléctrico deberá ser conectado a una fuente de poder sólo del tipo descrito en el instructivo de operación, o como se indique en el aparato.

12. Precaución debe ser tomada de tal manera que la tierra física y la polarización del equipo no sea eliminada.
13. Los cables de la fuente de poder deben ser guiados de tal manera que no sean pisados ni pellizcados por objetos colocados sobre o contra ellos, poniendo particular atención a los contactos y receptáculos donde salen del aparato.
14. El equipo eléctrico debe ser limpiado únicamente de acuerdo a las recomendaciones del fabricante.
15. En caso de existir, una antena externa deberá ser localizada lejos de las líneas de energía.
16. El cable de corriente deberá ser desconectado del cuando el equipo no sea usado por un largo periodo de tiempo.
17. Cuidado debe ser tomado de tal manera que objetos líquidos no sean derramados sobre la cubierta u orificios de ventilación.
18. Servicio por personal calificado deberá ser provisto cuando:
 - A: El cable de poder o el contacto ha sido dañado; u
 - B: Objetos han caído o líquido ha sido derramado dentro del aparato; o
 - C: El aparato ha sido expuesto a la lluvia; o
 - D: El aparato parece no operar normalmente o muestra un cambio en su desempeño; o
 - E: El aparato ha sido tirado o su cubierta ha sido dañada.

TRADEMARKS USED IN THIS MANUAL

Linux is a registered trademark of Linus Torvalds.

Windows and Windows NT are either registered trademarks or trademarks of Microsoft Corporation in the United States and/or other countries.

Any other trademarks mentioned in this manual are acknowledged to be the property of the trademark owners.

Contents

Chapter	Page
1. Specifications	7
2. Introduction	8
2.1 Overview	8
2.2 What's Included	8
2.3 Technical Description	8
2.3.1 Features	9
2.3.2 Input Ports	9
2.3.3 Output Ports (Reed Relay)	11
2.3.4 Software	12
3. Card Setup	13
4. Installation	14
Appendix A. Troubleshooting	15
A.1 Calling Black Box	15
A.2 Shipping and Packaging	16
Appendix B. Block Diagram	17

1. Specifications

Compliance: CE approval; FCC Part A, Class A

Channels: 16 input/16 output

Input Range: 3 to 12 VDC

Input Isolation: 400 V optical

Output Relay: 200 million closures

Throughput: 600 Hz

Relay Contact Power Ratings: 10 watts maximum

Relay Contact Voltage: 100 volts DC or AC maximum

Relay Contact Current: 0.5 amps DC or AC RMS maximum

Relay Contact Resistance: *Initial:* 0.15 ohms

Relay Rated Life: *Low load:* 200 million closures;
Maximum load: 100 million closures

Relay Contact Speed: *Operate:* 0.5 mS; *Release:* 0.5 mS; *Bounce:* 0.5 mS

Relay Maximum Operating Speed: 600 Hz

MTBF: Greater than 150,000 hours, excluding relays; relay life expectancy depends on actual application

Connectors: (1) DB78 female on card; (1) DB37 female and (1) DB37 male on “Y” cable

Temperature Tolerance: *Operating:* 32 to 122°F (0 to 50°C);
Storage: -4 to +158°F (-20 to +70°C)

Humidity Range: 10 to 90% noncondensing

Power: From the bus

Power Consumption: *Supply line:* +12 VDC, +5 VDC; *Rating:* 450 mA

Size: *Including goldfingers:* 4.2"H x 6"W (10.7 x 15.2 cm);
Excluding goldfingers: 3.8"H x 6"W (9.7 x 15.2 cm)

2. Introduction

2.1 Overview

The Digital I/O Card-16 provides 16 reed relays that can latch power, data, or other electronic signals for control applications and 16 optically isolated inputs to allow monitoring of off-board switch closures, relays, or for any other general-purpose monitoring needs. The card is PCI 2.1 bus compliant. Addressing, data, and control signals are TTL compatible.

2.2 What's Included

The Digital I/O Card-16 is shipped with the following items. If any of these items are missing or damaged, contact Black Box at 724-746-5500.

- Digital I/O Card-16
- Systems software (on a CD-ROM)
- This users' manual

2.3 Technical Description

The Digital I/O Card-16 provides four parallel input/output (I/O) ports. The ports are organized as ports A, B, C, and D. Ports A and B are input ports interfaced to optically-isolated inputs, while ports C and D are reed relay output ports. Assuming an I/O address of 300 Hex, Table 2-1 shows the port addresses.

Table 2-1. Port addresses.

Base Address	Hex	Decimal	Mode
Port A Address	300	768	Input Port (Opto-Input)
Port B Address	301	769	Input Port
Port C Address	302	770	Output Port (Reed Relays)
Port D Address	303	771	Output Port

2.3.1 FEATURES

- Selectable I/O port addressing from 100H through 3FFH.
- Two sets SPST relays (each set has eight relays).
- Two eight-bit input ports.
- DB37 male connector for relay outputs.
- DB37 female connector for optically isolated inputs.
- Highly reliable 10-VA DIP reed relays used.
- Multiple adapters can reside in same computer.
- All address, data, and control signals are TTL compatible.

2.3.2 INPUT PORTS

Ports A and B are 8-bit input ports connected to optically isolated input sensors. Each sensor can be used to interface a voltage input and then sense whether the voltage is on or off. Each sensor is isolated (with respect to a common ground) from every other sensor, and it's also isolated with respect to the host PC ground. This means that signals such as low-level AC line voltage, motor servo voltage, and control relay signals can be "sensed," or read by the PC, without the risk of damage due to ground loops or ground faults.

Each sensor input pair has a current-limiting resistor that is used to limit the input current to the opto-isolator. The opto-isolator has two "back-to-back" diodes internally. This allows AC or DC signals to be sensed, regardless of polarity. When the applied voltage is high enough to cause the LED in the opto-isolator to power on, the output of the opto-isolator goes low (0 volts) and the signal is read as a low logic level (binary 0) by the PC. When the input signal is too low to power on the opto-isolator, the output goes high and the port bit is read by the PC as a high logic level (binary 1).

The input impedance of each isolated input is approximately 560 ohms (factory default). The opto-isolator requires approximately 3 mA to power on. The maximum input current is 60 mA. You must consider two things when selecting the input resistor: The first is power-on voltage for the circuit to sense, and second is the maximum input voltage. Maximum input voltage must not provide too much power to the input resistor, and it must also not overdrive the opto-isolator input current specification. The following formulas apply:

Power-on current: 3 mA
 Isolator diode drop: 1.1 V
 Resistor power max.: 0.25 W

Power-on voltage = diode drop + (turn-on current) x (resistance)

Or :

$$1.1 + (.003) \times R$$

Maximum voltage = square root of (0.25 [resistor value])

Table 2-2 shows four common input resistors and the ranges associated with each.

Table 2-2. Input resistor ranges.

Input Resistor (ohms)	Value Power-On (volts)	Max. Input Range (volts)	Max. Current (mA)
220	1.76	7	27
560	2.8	12	20
1K	4.1	16	15
2.2K	7.7	24	10

The maximum input voltage can be increased by increasing the input resistor accordingly. Because socketed DIP resistor networks are used, they can easily be replaced with a different value. This can be done at the factory, if necessary. The input circuits are not intended for monitoring 120-volt AC circuits. In addition to being too high a voltage for the circuits, it is dangerous to have that high a voltage on the card.

Table 2-3 lists the input ports pin assignments.

Table 2-3. Pin assignments for sensor input ports (DB37 female labeled as input).

Port A Bit	P1 Pin	Port B Bit	P1 Pin
0	18, 37	0	10, 29
1	17, 36	1	9, 28
2	16, 35	2	8, 27
3	15, 34	3	7, 26
4	14, 33	4	6, 25
5	13, 32	5	5, 24
6	12, 31	6	4, 23
7	11, 30	7	3, 22
Ground	2, 20, 21		
+12 volts	19		
+5 volts	1		

2.3.3 OUTPUT PORTS (REED RELAY)

Reed relays provide very-high-quality, long-life, low-current (10-watt maximum), dry-contact switch closures. Reed relays are not suited for high-current applications and can be destroyed by inductive load switching (where a spark occurs across the contacts internally). The relays are normally open, and they close when energized. Each relay can be individually energized by writing a “1” to the proper port bit. Table 2-4 shows the output ports’ pin assignments.

Table 2-4. Output ports (reed relay) pin assignments (DB37 male labeled as output).

Port C Bit	Relay	P2 Pin	Port D Bit	Relay	P2 Pin
0	K16	2, 20	0	K8	10, 28
1	K15	3, 21	1	K7	11, 29
2	K14	4, 22	2	K6	12, 30
3	K13	5, 23	3	K5	13, 31
4	K12	6, 24	4	K4	14, 32
5	K11	7, 25	5	K3	15, 33
6	K10	8, 26	6	K2	16, 34
7	K9	9, 27	7	K1	17, 35
Ground	18, 36, 37				
+5 volts	19				
+12 volts	1				

2.3.4 SOFTWARE

The Digital I/O Card-16 ships with an I/O suite of Windows® 98/Me/XP, Windows NT®, and Windows 2000 drivers. These drivers provide you with a consistent and straightforward application program interface (API), allowing the developer to concentrate on the details of the application as opposed to low-level driver development. Popular development environments, including Visual C++, Visual Basic, and Delphi, are supported for application development. I/O includes a utility for configuring the driver parameters under Windows, further simplifying installation.

For DOS, QNX, Linux® and other operating systems, please refer to the software included with your card.

Programming Examples

All examples assume a base address of 300 Hex.

To read inputs at port A :

```
MOV DX, 300H      ;Set DX to Port A
IN AL, DX         ;Get Input Port Data
NOT AL           ;data read is negative
                 logic
```

Programming example to set Relay #3 on, write a “1” in bit position D3, to port address Base+3, or 303 Hex.

```
MOV DX, 303H      ;Set DX to Port D
MOV AL, 00001000B ;Set bit 3 to a '1'
OUT DX, AL
```

Another method that takes into account the read-back capability of the output ports C and D:

```
MOV DX, 303H      ;Set DX To Port D
IN AL, DX         ;Get old port setting
NOT AL           :Invert bits- see note below
OR AL, 00001000B ;OR in bit 3
OUT DX, AL        ;Set Bit 3
```

NOTE

Reading back the ports (C and D) results in the binary complement of the output.

3. Card Setup

Table 3-1 lists the addresses for the card.

Table 3-1. The card's address assignments.

Address	Mode	D7	D6	D5	D4	D3	D2	D1	D0
Base+0	RD/WR	PAD7	PAD6	PAD5	PAD4	PAD3	PAD2	PAD1	PAD0
Base+1	RD/WR	PBD7	PBD6	PBD5	PBD4	PBD3	PBD2	PBD1	PBD0
Base+2	RD/WR	PCD7	PCD6	PCD5	PCD4	PCD3	PCD2	PCD1	PCD0
Base+3	RD/WR	PDD7	PDD6	PDD5	PDD4	PDD3	PDD2	PDD1	PDD0
Base+4	RD/WR	{0}	{0}	{0}	{0}	{0}	{0}	{0}	{0}
Base+5	RD/WR	IRQEN	IRQST	{0}	{0}	{0}	{0}	1RC1	1RC0
Base+6	RD only	{0}	{0}	{0}	{0}	{0}	{0}	{0}	{0}
Base+7	RD only	{0}	{0}	{0}	{0}	{0}	{0}	{0}	{0}

NOTE

All ports are set to input after reset or power-up. Interrupt source is Base+0 bit D0. When selecting the Interrupt Mode, always disable interrupts before changing or setting states. This will help prevent inadvertent or unexpected interrupts from occurring. When using the high- and low-level interrupts, a change in state of the input must occur before the interrupt can be cleared. The device providing the input to Base+0, bit D0, must do this.

PAD0–7 =Port A (Base+0)

PBD0–7 =Port B (Base+1)

PCD0–7 =Port C (Base+2)

PDD0–7 =Port D (Base+3)

IRC0–1 =Interrupt Mode select (Base+5)

IRC1	IRC0	
------	------	--

0	0	low level
---	---	-----------

0	1	high level
---	---	------------

1	0	falling edge
---	---	--------------

1	1	rising edge
---	---	-------------

IRQEN =enable interrupts (Base+5)

0=disabled

1=enabled (disabled after reset or power-up)

IRQST =interrupt status (Base+5)

1=interrupt pending (reading the bit clears interrupt)

4. Installation

The Digital I/O Card-16 can be installed in any PC expansion slot. Before you install the card, make sure you have followed the configuration instructions in **Chapter 3**.

To install the card:

1. Turn off all PC power and disconnect the power cord.
2. Remove the cover of the PC case.
3. Locate two available slots and remove the blank metal slot covers.
4. Gently insert the Digital I/O Card-16 into the slot. Make sure the card is seated properly. Insert the cable bracket into the adjacent slot and screw it in place.
5. Replace the PC's cover.
6. Connect the power cord.

Installation is complete.

Appendix A. Troubleshooting

Following these simple steps can eliminate most common problems without the need to call Technical Support.

1. Install software first. After installing the software, add the hardware. This places the required installation files in the correct locations.
2. Identify all I/O adapters currently installed in your system. This includes your onboard serial ports, controller cards, sound cards, etc. The I/O addresses used by these adapters, as well as the IRQ (if any), should be identified.
3. Make sure that there is no conflict with currently installed adapters. No two adapters can occupy the same I/O address and may not be allowed to share IRQs.
4. Make sure the system's adapter is securely installed in a motherboard slot.

A.1 Calling Black Box

If you determine that your Digital I/O Card-16 is malfunctioning, do not attempt to alter or repair the unit. It contains no user-serviceable parts. Contact Black Box at 724-746-5500.

Before you do, make a record of the history of the problem. We will be able to provide more efficient and accurate assistance if you have a complete description, including:

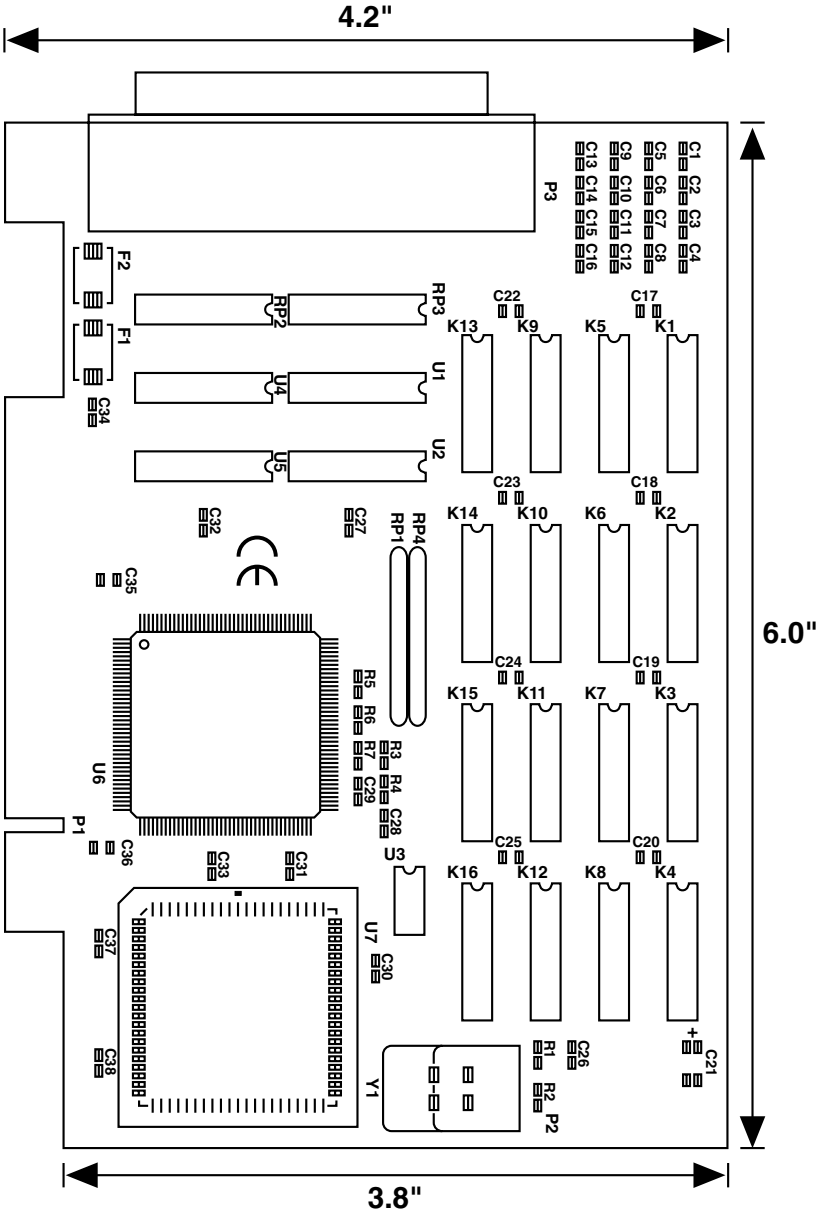
- the nature and duration of the problem.
- when the problem occurs.
- the components involved in the problem.
- any particular application that, when used, appears to create the problem or make it worse.

A.2 Shipping and Packaging

If you need to transport or ship your Digital I/O Card-16:

- Package it carefully. We recommend that you use the original container.
- If you are shipping the Digital I/O Card-16 for repair, make sure you include everything that came in the original package. Before you ship, contact Black Box to get a Return Authorization (RA) number.

Appendix B. Block Diagram





© Copyright 2005. Black Box Corporation. All rights reserved.

1000 Park Drive • Lawrence, PA 15055-1018 • 724-746-5500 • Fax 724-746-0746